What Is Claimed Is:

1. A vehicle control system including a sensor cluster within a housing generating a plurality of signals including a roll rate signal, a pitch rate signal, a yaw rate signal, a longitudinal acceleration signal, a lateral acceleration signal, and a vertical acceleration signal, the system comprising:

an integrated controller comprising a reference signal generator, said reference signal generator generating a reference signal as a function of a kinematics road constraint condition, a dynamic road constraint condition, and singularity removal logic;

a dynamic system controller receiving said reference signal and generating a dynamic control signal in response thereto; and

a vehicle safety system controller receiving said dynamic control signal and further generating a vehicle safety device activation signal in response thereto.

2. A system as in claim 1, wherein said sensor cluster comprises at least three angular rate sensors and at least three linear acceleration sensors.

3. A system as in claim 1, wherein said integrated controller further comprises:

at least one of a road profile unit generating a road profile signal,

an attitude signal unit generating a vehicle attitude signal,

a global attitude signal unit generating a global position signal,

a directional unit generating a vehicle direction signal,

a directional velocity unit generating a vehicle direction velocity signal,

a sensor plausibility unit generating a sensor plausibility signal,

an abnormal state unit generating an abnormal state signal including information regarding abnormal vehicle conditions,

a sensor signal compensating unit generating a mounting sensor error correction signal,

a force and torque estimation unit generating force and torque signal in response to forces and torques applied to the vehicle,

a car body to fixed body unit generating a body fixed to rollover fixed foam signal, or

a normal loading unit generating a normal signal, and

a vehicle parameter unit generating a vehicle parameter determination signal,

wherein said integrated controller generates said reference ~~lateral velocity~~ signal from at least one of said attitude signal reference computation, said road profile signal, said vehicle attitude signal, said global position signal, said vehicle direction signal, said sensor plausibility signal, said abnormal state signal, said mounting sensor error correction signal, ~~or~~ and said force and torque signal.

4. A system as in claim 1, wherein signals generated from said integrated controller initiate control commands for various control systems including at least one of ~~, but not limited to:~~ yaw stability control, roll stability control, ABS control, traction control, slip control, power-train control, transmission control, drive-train control, suspension control, anti-roll-bar control, vehicle leveling control, fuel economy

control, active safety, passive safety, emission control, tire under-inflation detection and monitoring, and tire imbalance monitoring and detection, sensor plausibility checks, sensor signal compensating, and sensor signal real-time calibration.

5. The system of claim 1, wherein said reference signal generator ~~integrated controller~~ generates said a reference signal, including at least one of a reference lateral velocity signal, a reference roll attitude signal, a reference pitch attitude signal, and a reference side slip angle signal, as a function of a reference computational method including said kinematics road constraint.

6. The system of claim 5, wherein said reference signal generator ~~integrated controller~~ generates said reference side slip angle signal from said dynamic road constraint condition as a function of said kinematics road constraint.

7. The system of claim 5, wherein said singularity removal logic comprises a blending scheme generating said reference lateral velocity signal as a function of eliminating a singular point in a computation of said reference signal.

8. The system of claim 5, wherein said reference signal generator generates said reference lateral velocity signal as a function of said dynamic road constraint condition through logic projecting lateral vehicle accelerations along an average road surface in response to said ~~a~~ lateral acceleration signal, said ~~relative~~ reference roll attitude signal, and said ~~relative~~ reference pitch attitude signal generated within said integrated controller.

9. The system of claim 5, wherein said reference signal generator projects a yaw rate ~~sensor~~ signal along a vertical

axis perpendicular to an average road surface using ~~a~~ said roll rate signal ~~sensor~~, ~~a~~ said pitch rate signal ~~sensor~~, ~~a~~ said yaw rate signal ~~sensor~~ and relative roll and pitch attitude signals generated within said integrated controller,

said reference signal generator generating said reference side slip angle signal as a function of said lateral acceleration signal and said yaw rate signal,

said reference signal generator generating said reference lateral velocity signal as a function of said reference side slip angle signal.

10. The system of claim 5, wherein said reference signal generator ~~integrated controller~~ generates said reference lateral velocity signal as a function of said vertical acceleration signal, said roll rate signal, said yaw rate signal, and a vehicle speed signal.

11. The system of claim 5, wherein said reference signal generator ~~integrated controller~~ generates said reference roll attitude signal as a function of a differentiation of said reference lateral velocity signal, said pitch rate signal, said yaw rate signal, and a vehicle speed signal.

12. The system of claim 5, wherein said reference signal generator ~~integrated controller~~ generates said reference pitch attitude signal as a function of said reference lateral velocity signal, said yaw rate signal, a differentiation of ~~said~~ a vehicle speed, and said longitudinal accelerometer signal.

13. The system of claim 5, wherein said reference signal generator ~~integrated controller~~ generates said reference side slip angle signal or ~~said~~ a relative yaw attitude signal as a function of said reference lateral velocity signal and a vehicle speed signal.

14. The system of claim 1, wherein said singularity

removal logic comprises eliminating a singular point in a computation of said reference ~~lateral velocity~~ signal through application of a limit theorem, such that when said roll rate signal is below a threshold, said reference signal generator generates said reference ~~lateral velocity~~ signal as a function of said limit theorem.

15. A control system for an automotive vehicle comprising:

a housing;

a sensor cluster within said housing comprising a plurality of angular rate sensors generating angular rate signals and a plurality of linear acceleration sensors generating linear acceleration signals, wherein said angular rate sensors and said linear acceleration sensors comprise an IMU;

a wheel speed sensor generating a wheel speed signal corresponding to a wheel speed of the vehicle;

a steering angle sensor generating a steering angle signal;

an integrated controller receiving said angular rate signals, said linear acceleration signals, said wheel speed signal, and said steering angle signal, said integrated controller generating a lateral velocity signal, a roll attitude signal, a pitch attitude signal, and a side slip angle signal as functions of a reference computational method comprising a kinematics road constraint, ~~and~~ said angular rate signals, said linear acceleration signals, said wheel speed signal, and said steering angle signal;

a vehicle dynamic controller receiving said lateral velocity signal, said roll attitude signal, said pitch attitude signal, and said side slip angle signal and generating a dynamic control signal in response thereto; and

a dynamic stability control system receiving said

~~rollover~~ dynamic control signal and operating a safety device in response thereto.

16. A system as in claim 15, wherein said vehicle dynamic controller controls vehicle control objectives~~, such as, but not limited, to~~ including at least one of yaw stability control, roll stability control, ABS control, traction control, slip control, power-train control, transmission control, drive-train control, suspension control, anti-roll-bar control, vehicle leveling control, fuel economy control, active safety, passive safety, and emission control, and

wherein said vehicle dynamic controller controls vehicle abnormal state monitoring~~, such as, but not limited to,~~ including at least one of tire under-inflation detection and monitoring, tire imbalance monitoring and detection, excessive suspension wearing, and

wherein said vehicle dynamic controller conducts at least one of a sensor plausibility check, sensor signal compensation, and sensor signal real-time calibration.

17. The system as in claim 15, wherein said integrated controller further generates a sensor plausibility check.

18. The system as in claim 15, wherein said integrated controller further monitors the abnormal conditions of the vehicle in motion.

19. The system as in claim 15, wherein said integrated controller further corrects sensor mounting errors of said sensor cluster with respect to a body of said vehicle ~~body~~.

20. A vehicle system having an IMU sensor cluster including at least three angular rate sensors and at least

three linear acceleration sensors, said sensor cluster generating vehicle dynamic signals including a roll rate signal, a yaw rate signal, a pitch rate signal, a longitudinal acceleration signal, a lateral acceleration signal, and a vertical acceleration signal, the system comprising:

an integrated controller comprising a reference signal generator, said reference signal generator generating a reference lateral velocity signal as a function of a kinematics road constraint condition, a dynamic road constraint condition, and singularity removal logic, said singularity removal logic computing said reference lateral velocity signal as a function of eliminating a singular point in a computation of said reference lateral velocity signal,

said integrated controller generating a lateral velocity signal, a roll attitude signal, a pitch attitude signal, and a side slip angle signal as a function of a reference computational method including said kinematics road constraint,

said integrated controller generating ~~a~~ said lateral velocity signal and a reference side slip angle signal from said dynamic road constraint condition as functions of said kinematics road constraint condition,

said singularity removal logic comprising a blending scheme computing said reference lateral velocity signal as a function of eliminating a singular point in a computation of said reference lateral velocity signal,

said reference signal generator generating said reference lateral velocity signal as a function of said dynamic road constraint condition through logic projecting lateral vehicle accelerations along an average road surface in response to said lateral acceleration signal, a relative roll attitude signal, and a relative pitch attitude signal generated within said integrated controller,

said reference signal generator projecting ~~a~~ said yaw

rate ~~sensor~~ signal along a vertical axis perpendicular to an average road surface using said relative roll and pitch attitude signals generated within said integrated controller,

said reference signal generator generating said reference side slip angle signal as a function of the lateral acceleration signal and the yaw rate signal,

said reference signal generator generating said reference lateral velocity signal as a function of said side slip angle signal;

a dynamic system controller receiving said reference lateral velocity signal and generating a dynamic control signal in response thereto; and

a vehicle safety system controller receiving said dynamic control signal and further generating a vehicle safety device activation signal in response thereto.

21. The system of claim 20, wherein said singularity removal logic comprises:

eliminating a singular point in ~~a~~ said computation of said reference lateral velocity signal through application of a limit theorem, such that when the roll rate signal is below a threshold, said reference signal generator generates said reference lateral velocity signal as a function of said limit theorem.

22. A method for controlling a safety device for a vehicle comprising:

generating a reference lateral velocity signal as a function of a kinematics road constraint condition, a dynamic road constraint condition, and singularity removal logic~~;~~ for

eliminating a singular point in a computation of said reference lateral velocity signal;

generating said reference lateral velocity signal, a reference roll attitude signal, a reference pitch attitude

signal, and a reference side slip angle signal as a function of a reference computational method including limitations of said kinematics road constraint;

generating said reference lateral velocity signal and said reference side slip angle signal from said dynamic road constraint condition as functions of said kinematics road constraint;

generating a dynamic control signal in response to said reference lateral velocity signal; and

receiving said dynamic control signal and further generating a vehicle safety device activation signal in response thereto.

23. The method of claim 22 further comprising generating said reference lateral velocity signal as a function of said dynamic road constraint condition through logic projecting lateral vehicle accelerations along an average road surface in response to a lateral acceleration signal, a relative roll attitude signal, and a relative pitch attitude signal all generated within said integrated controller.

24. The method of claim 22 further comprising projecting a yaw rate ~~sensor~~ signal along a vertical axis perpendicular to an average road surface using a roll rate signal ~~sensor~~, a pitch rate signal ~~sensor~~, a yaw rate signal ~~sensor~~ and relative roll and pitch attitude signals generated within said integrated controller.

25. The method of claim 22 further comprising generating said reference side slip angle signal as a function of ~~said~~ the lateral vehicle accelerations and ~~said~~ a yaw rate signal.

26. The method of claim 22 further comprising generating said reference lateral velocity signal as a function of ~~said~~ a side slip angle signal.

27. A method for controlling a safety device for a vehicle comprising:

generating a roll rate signal;

generating a pitch rate signal;

generating a yaw rate signal;

generating a longitudinal acceleration signal;

generating a lateral acceleration signal;

generating a vertical acceleration signal;

generating a reference lateral velocity signal as a function of said roll rate signal, said pitch rate signal, said yaw rate signal, said longitudinal acceleration signal, said lateral acceleration signal, and said vertical acceleration signal, a kinematics road constraint condition, a dynamic road constraint condition, and singularity removal logic, said singularity removal logic computing said reference lateral velocity signal as a function of eliminating a singular point in a computation of said reference lateral velocity signal;

generating ~~a~~ said reference lateral velocity signal, a reference roll attitude signal, a reference pitch attitude signal, and a reference side slip angle signal as a function of a reference computational method including said kinematics road constraint;

generating a lateral velocity signal and said reference side slip angle signal from said dynamic road constraint condition as functions of said kinematics road constraint;

generating said reference lateral velocity signal as a function of said dynamic road constraint condition through logic projecting lateral vehicle accelerations along an

average road surface in response to ~~a~~ said lateral acceleration signal, a relative roll attitude signal, and a relative pitch attitude signal generated within said integrated controller;

projecting a yaw rate ~~sensor~~ signal along a vertical axis perpendicular to an average road surface using ~~a~~ said roll rate ~~sensor~~ signal, ~~a~~ said pitch rate ~~sensor~~ signal, ~~a~~ said yaw rate ~~sensor~~ signal and said relative roll and pitch attitude signals generated within said integrated controller;

generating said reference side slip angle signal as a function of said lateral acceleration signal and said yaw rate signal;

generating said reference lateral velocity signal as a function of said reference side slip angle signal;

generating a dynamic control signal in response to said reference lateral velocity signal; and

controlling a vehicle safety device in response to said safety device control signal.

28. A method as in claim 27, wherein said controlling said vehicle safety device further comprises controlling yaw stability control, roll stability control, ABS control, traction control, slip control, power-train control, transmission control, drive-train control, suspension control, anti-roll-bar control, vehicle leveling control, fuel economy control, active safety, passive safety, and emission control, wherein said controlling said vehicle safety device further comprises controlling vehicle abnormal state monitoring, including: tire under-inflation detection and monitoring, tire imbalance monitoring and detection.